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December 1980

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NASA Aviation Safety Reporting System: Quarterly Report No. 12

Ames Research Center
Moffett Field, Calif. 94035

and

Aviation Safety Reporting System Office
Battelle's Columbus Division
Mountain View, Calif. 94043

NASA

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NASA AVIATION SAFETY REPORTING SYSTEM:

QUARTERLY REPORT NO. 12

Ames Research Center

and

Aviation Safety Reporting System Office*

SUMMARY

This twelfth quarterly report of ASRS operations contains two special studies. The first, Problems in Briefing of Relief by Air Traffic Controllers, addresses various problems that arise when duty positions are changed by controllers; the second study, Altimeter Reading and Setting Errors as Factors in Aviation Safety, discusses problems associated with altitude-indicating instruments. A sample of reports from pilots and controllers is included, covering the topics of ATIS broadcasts and clearance readback problems. The concluding section of the report presents a selection of Alert Bulletins, with their responses.

INTRODUCTION

This is the twelth in a series of reports of the activities of the NASA Aviation Safety Reporting System (ASRS) (refs. 1-11). ASRS operates under a memorandum of agreement signed on August 15, 1975 by the National Aeronautics and Space Administration and the Federal Aviation Administration.

This report contains two studies derived from information included in the ASRS database. The first is a discussion of problems associated with the briefing of relief controllers within the Air Traffic Control system. The second describes the various types of altimeters in current aviation service, and problems associated with their use. An opening section presents a collection of reports received by ASRS illustrating specific types of safety-related occurrences. The final section presents a sampling of Alert Bulletins issued by ASRS and the responses to them.

AVIATION SAFETY REPORTS

ASRS Quarterly Reports have usually contained a section providing a sampling of reports received through the reporting system. This report continues that plan, presenting narratives submitted by ASRS reporters from throughout the aviation community. Included in this edition are representative examples of reports dealing with ATIS broadcasts, and with clearance readbacks.

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*Battelle's Columbus Division, Mountain View, California 94043.

ATIS Broadcasts

Reports concerned primarily with other matters frequently mention ATIS broadcasts merely as a part of a long detailed narrative. The reports in the following group have been selected as representative of occurrences in which the ATIS figured in a significant way. Lack of clarity of the broadcast message is frequently cited – a charge that cannot be made against the language used by the reports in the first two narratives in this series. The two, as well as no. 3, are also distinguished by unusual brevity. Although the reports in this discussion are of relatively recent submission, it should be noted that FAA has been pursuing a vigorous program aimed at terminal information dissemination improvement. This effort appears to be bearing fruit. There has been a significant decline in ATIS deficiencies reported to ASRS in the past year.

1. ATIS is a pain in the neck. When you finally hear through the static, station identifiers, and poor recordings, the person who is doing the recording races through the dialogue so rapidly it has to be listened to at least three times before all of the message is understood.

* * *

2. I submitted a pilot report to my company in hopes they could convince ABC tower to eliminate field condition reports when not necessary and reduce the extraneous gobbly gook from the ATIS.

* * *

3. ATIS – using runway 5. Approach Control issued approach clearance to runway 23. Localizer for runway 23 was not operating. Approach Control would not answer question as to status of runway 23 ILS. Leveled out at 2,500 ft, tracking 210° bearing to runway 23 LOM. Approach Control said changing runways; contact Tower. Landed runway 5. Ground Control said runway change was 30 minutes old. Danger is obvious.

* * *

When ATIS performs its mission in a satisfactory fashion – as it undoubtedly does thousands of times each day – it provides no reason for its being the subject of an ASRS report. Most reports received on the subject relate to false expectations. From his understanding of a broadcast, a pilot is led to anticipate – and to plan on – a certain course of action. Not infrequently, for one reason or another, he is forced to change his plan. The following reports provide insight into some problems of this sort.

4. Approaching at XX15, ATIS was transmitting information code Echo: clear, visibility 7 miles, temperature 81, wind 160 at 12, altimeter 30.04, runway 22 left . . . plus the usual noise abatement warnings. There was no time given for the weather observation. Terminal weather, requested shortly thereafter from nearby Flight Watch, was: estimated 500 broken, 2,000 ft overcast, visibility 2-1/2 miles, fog, wind south at 6. At XX25 ATIS was still broadcasting information Echo.

Requested current weather from Flight Service and received XX12 Special: Estimated 400 broken, visibility 1-1/2 miles, fog, temperature 74, dew point 71, wind 190 at 5. This discrepancy between ATIS and actual weather is a common occurrence at this airport and time of observation is seldom on the broadcast. Similar discrepancies have been noted at other locations.

Reporter's recommendations: It is convenient to have up-to-date ATIS weather information especially in times of deteriorating conditions. Also, time of observation on ATIS gives a clue as to when weather information should be requested from other sources. European weather observations are taken every half hour and their ATIS broadcasts are updated accordingly.

* * *

Naturally, most reports dealing with ATIS are submitted by the recipients of the information – the flightcrews. In contrast, the next report was written by a controller. It suggests a reason for potential information inaccuracy and suggests caution in recording.

5. When the departure ATIS is put on the air, the controller cannot verify that the information is correct. The volume on the line is so weak the wrong information, such as altimeter, temperature, etc., could easily be put on the ATIS and not caught until an accident has occurred.

* * *

A large proportion of the ATIS criticisms revealed in the ASRS reports deals with the runway-in-use problem. When the runway assigned, either to taxiing aircraft or those airborne, differs from the ATIS designated one, problems ensue.

6. ATIS at the time specified runway 34 as active. Aircraft were observed landing on runway 34. Pilot's aircraft was, I believed, cleared to taxi to runway 34 via the perimeter taxiway, to hold short of runway 12. At the intersection of the perimeter taxiway and taxiways A and B, aircraft continued southbound on perimeter taxiway toward runway 34. The ground controller then questioned the direction and destination of the aircraft, saying that the aircraft had been cleared originally to runway 30. Pilot disputed this assertion. Aircraft was then re-cleared to runway 34. Although there was no immediate safety problem attendant on this incident, it is my opinion that irrespective of actual instructions given, a definite potential for critical misinterpretation was present with ATIS giving runway 34 as active, and aircraft actually landing on runway 34.

* * *

7. On taxi-out we were advised by Tower to contact Ground Control. Ground Control advised that we had made an unauthorized crossing of active runway 15. As we were number 2 for takeoff, we did not have time to discuss the incident with him and told him that we were not aware that runway 15 was active. At this point he dropped the subject and we returned to Tower for takeoff. When calling for taxi

clearance the frequency was very congested. We were advised to hold for a light aircraft taxiing behind us, then to follow the second aircraft coming around the concourse, to runway 18. While following, I crossed runway 15, but only after looking to see if runway 15 was clear and that there were no aircraft on final. However, I could see two aircraft coming down the river to land on runway 18 (the weather being VFR). We switched to Tower frequency after crossing runway 15. After takeoff I again listened to the ATIS to see if we had missed hearing of runway 15 being active. The ATIS said that river approaches to 18 were being made and made no mention of runway 15 being used. As I said, the congestion on Ground Control at the time we received taxi clearance was very high, and if runway 15 was active the ground controller should have made sure we knew to hold short. At no time did we acknowledge to hold short of runway 15.

* * *

8. ATIS information said ILS runway 24 with circling approach to runway 15; weather 2,000 overcast, 20, wind 150°, gusting to 35. Crew descended to circling minimums instead of VFR traffic altitude. ATIS and clearance should have said ILS runway 24 with visual approach to land runway 15.

* * *

9. Thirty miles west of the VOR I listened to ATIS XRAY and understood that 5L was closed, approaches being made on 5R. I contacted Approach Control and accepted vectors to 5R. After advising airport in sight I was handed off to Tower, which advised cleared for approach 5R. After landing on 5R, I encountered barricades. Tower immediately advised I had landed on closed runway.

I believe this happened because (1) the quality of the ATIS broadcast was poor; (2) upon being cleared for the approach to 5R, I assumed I was cleared to land on 5R; (3) I was late and was hurrying; (4) if Tower had noticed I was approaching 5R and advised me to go around, I would not have landed on it. Note: the next ATIS WHISKY was very clear and concise with no problem understanding it.

* * *

10. On approach to airport traffic area, I was monitoring ATIS. Runway in use sounded like 11 right and 11 left. Being the second time I have flown to this airport, I assumed this was correct. I called Tower at 5 miles out with information LIMA; the response was to report base over a hotel. As I approached what should have been the approach end of the runway I called the hotel, but traffic seemed to be taking off in the wrong direction. I then told Tower I must be at the wrong airport since there was no runway 11 and traffic was going the wrong way. I then climbed out over the traffic area and overflew the runways, seeing that they were 1 and 19. Listening to the ATIS again several times, the runway in use sounded like "1 on the right and 1 on the left." Since "niner" was used several times in the ATIS, I do not think I was confusing "niner" with "on the." When I called Tower they did not report any runway to use; just to report on base. I assumed the ATIS was correct

and ended up at the departure end of the runway. My father, also a licensed pilot, was with me and was as confused as I was. We had both completed our biannual flight reviews within the last month.

* * *

11. ATIS gave landing runway as 23L and no other information was given during descent and approach from 10,000 ft. Aircraft A was given a heading of 250° to intercept the localizer. I questioned the heading due to the outer marker position and was informed that the intercept looked good on radar. Within 20 seconds the controller asked if we were receiving the localizer and we confirmed that we were. He then questioned us as to the frequency of the ILS to runway 28. We then told him we were tuned to the runway 23 ILS and were changing over. Aircraft B, which was following us, told Approach that he too was expecting runway 23 and immediately requested descent to visual conditions for a base leg to 23L. At about 2,200 ft we were changed to Tower frequency and cleared to land 23L. The tower operator then corrected himself and cleared us to land on runway 28.

Readbacks

A well-known aviation motto holds that a clearance is not a clearance until it has been heard and acknowledged; "heard, *understood* and acknowledged" would make the point even better. Notwithstanding this maxim, acknowledgment of clearances and instructions is subject to a number of complicating factors. From its earliest days, ASRS has received a continuing stream of reports from controllers and from flightcrews describing incidents in which the acknowledgment – "readback" in the vernacular – has in some way contributed to a lapse in the smooth functioning of the air traffic control system. Reports tell of busy controllers who assume, in the absence of a readback, that a clearance has been received when in fact it has not been heard by the intended recipient. More often, a message is read back incorrectly, either because it was misunderstood or because of carelessness in its repetition. In another variant of the problem, a controller delivers, because of distraction, absent-mindedness, or some other manifestation of human imperfection, an unintentionally incorrect instruction. In this version, flightcrew acknowledgment followed by compliance presents the controller with an unwelcome surprise. FAA has advised ASRS that a new S.O.P. now in preparation will deal particularly with this subject from the controller's point of view.

Many reports of altitude deviations – or of deviations from some other specified performance parameter – are submitted to ASRS because an incorrect readback went unchallenged. The "heard what he expected to hear" syndrome is operative in these narratives and accounts for many flightcrew assumptions not in agreement with the controller's intent. In turn, many controllers have accepted such readbacks automatically. The heavy workload in ATC facilities and, during certain phases of flight, in cockpits, can easily lead to this form of imperfect performance; the result can vary from uncomplicated change of plan to serious loss of separation between aircraft.

In the normal course of events, reports come to ASRS only when there has been a disturbance in the proper operation of the aviation system. The first report in this series is unusual in providing an illustration of the system working properly. An alert controller caught an erroneous readback and managed to save the day, despite pilot mind-set that made the task more than merely routine.

1. Light twin aircraft conducting visual approach to runway 24L was cleared to land on runway 24L and readback runway 25L. He was informed that his readback was not correct; clearance to land on 24L was reissued with emphasis on the runway assignment. The aircraft nevertheless left the final approach course for runways 24 and flew toward the final approach course to runways 25. He was assigned a heading which would return him to the runway 24 final approach course and subsequently landed without further incident. The absence of traffic on the runway 25 final approach course was coincidental.

* * *

Many reports leave unanswered the question of whether a message was acknowledged. These accounts involve a controller-flightcrew misunderstanding but do not mention either delivery or receipt of a readback. Although generally understood to represent good practice, readbacks may be omitted for reasons of frequency congestion, workload, or carelessness; the omission may pass without controller comment for similar reasons.

2. Inbound aircraft A was instructed to maintain 6,000 ft. Several minutes later aircraft A reported out of 8,000 ft for 4,000 ft but the controller did not absorb the transmission. A few minutes later aircraft A came within 1 mile and 400 ft of aircraft B. Aircraft A later advised he descended because he was issued a descent clearance. Descent clearance in fact had not been issued.

* * *

3. Upon completion of maneuvers in the training area, the student acting as evaluator requested clearance to the airport. The aircraft was in a block altitude of 12,000-14,000 ft. Both the instructor pilot and the student thought the controller told them to turn left to a heading of 010° and descend to and maintain 10,000 ft. At 10,700 the controller requested altitude; the crew responded 10,700 ft. The controller told the aircraft to descend to 9,000 ft and to expedite through 10,000. The controller also stated the aircraft had been cleared to 12,000, not 10,000 ft. There are two contributing causes for this occurrence: 99% of all clearances out of the area to this airport are to descend to and maintain 10,000 ft. As the instructor, I was conditioned to descend to 10,000 by many previous flights. The controller may have said 12,000 ft but I was programmed for 10,000.

* * *

Readbacks may be heard but not listened to; a pilot report and three reports from controllers are typical of this problem.

4. Our aircraft was cleared from 14,000 ft to 8,000. After leveling off at 8,000, we were told that we were only cleared to 11,000. We read back 8,000 ft and as we descended through 11,000 were never told by ATC that we were off our altitude, as they usually do. If ATC would notify crews of altitude discrepancies, the aircrew could take action to avoid the problem.

* * *

5. In the process of being relieved from departure control position, I issued a turn and restated maintain 5,000 ft. As the pilot read back the clearance I continued to brief my relief and did not hear the readback. Inbound traffic at 6.000 ft reported the aircraft above him. The controller who relieved me asked the pilot to verify altitude. He replied out of 6,900 and said that we had issued 8,000. The recording showed that 5,000 was indeed issued, but the pilot had read back 8,000. Evasive action was not required. The situation occurred because I was busy with other duties (being relieved) and did not stop to listen to the clearance readback.

* * *

6. While working a combined sector with no handoff position, I assigned inbound aircraft A 7,000 ft to provide separation with outbound aircraft B. The pilot of A read back the arrival instructions but included the wrong altitude, 6,000 ft. I missed the altitude and acknowledged the readback. I noticed aircraft A descending out of 7,000 and immediately issued traffic and reassigned 7,000 ft.

* * *

7. Cleared aircraft A to POPPS to hold northwest of V97, left turns. He read back FARMM and I missed his incorrect readback. We had aircraft hold – at FARMM at his altitude and could have had a system error.

* * *

A few reports suggest that departure from strictly standard phraseology or usage can generate confusion. In this one there is a possibility that radio reception may have added its own contribution.

8. Prior to descent we were cleared at pilot's discretion out of FL270 to 240. Upon switching to new sector we thought the controller said to *maintain* 270, to expect 240 later; we read that back. A few minutes later he gave us a 50° right turn if we had not left 270. We began descent and turn immediately. It is apparent that on initial contact, the controller said to *vacate* 270, but he apparently did not listen when we read back *maintain* 270.

* * *

There are many permutations of the basic plot; altitudes figure prominently in these stories, but many tell of misunderstood runway assignments, vector headings, restrictions, and fixes. Distraction from the immediate task appears as the villain in most of the reports, but there are others: for example, cockpit coordination or disagreement and workload. Flightcrew coordination is obvious in the next report. The final narrative in this section suggests that workload must have been heavy over a considerable geographic area. An altitude other than that desired by ATC was maintained through three center sectors before being noticed and corrected.

9. Aircraft was cleared from FL220 to descend and maintain 15,000 ft. The pilot flying understood the altitude assignment as 10,000 ft. The nonflying pilot

understood and read back the correct altitude of 15,000. Passing 12,000 ft the pilot flying stated, "passing 12 for 10," at which time the nonflying pilot said we were only cleared to 15,000. We then advised Center of the error. No other aircraft were involved and no evasive action was taken. The situation occurred due to lack of crew coordination.

* * *

10. Aircraft was assigned 11,000 ft but read back 10,000 and climbed to 10,000. He flew through two more sectors before the error was detected. Two of the sectors were very busy and were being worked by only one controller instead of the required two.

PROBLEMS IN BRIEFING OF RELIEF BY AIR TRAFFIC CONTROLLERS

Ralph Grayson*

Introduction

A substantial majority of occurrence reports submitted to the NASA Aviation Safety Reporting System by pilots and air traffic controllers contain evidence of problems in the transfer of information among the participants in the National Aviation System. Although failures in information transfer between ground and aircraft are most common, there are also many failures within the cockpit and within the ATC system. Because such failures are often the precursors of other failures, it is important to gain an understanding of what they are and how they occur.

The briefing of a relieving controller by the controller being relieved is a pure information transfer exercise. There is always a potential for failure in transferring necessary information, and thus the possibility for later failures of separation. Since briefing is invariably verbal, it is subject to the many sources of error inherent in oral communications. The ASRS has received a small but steady flow of reports concerning problems associated with briefing of relieving controllers; this discussion summarizes an analysis of such reports undertaken to shed light on the nature of the errors involved and their sources.

Objective

The objective of this study was to characterize the types of human errors reported in connection with briefing of relief in air traffic control operations, and to examine the factors associated with these errors.

Approach

ASRS Reports associated with briefing of relief (BOR) were counted to evaluate temporal trends in the submission of such reports. Fifty-two occurrences were chosen for detailed study. These reports were examined and categorized as to reporter, errors committed, and factors associated with the errors. An examination of the resulting array of data produced some thoughts on reducing the rate of errors.

For purposes of this study, a briefing-of-relief problem was considered to be a failure to transfer information completely and accurately from an air traffic controller operating a position to another controller who was to assume subsequent responsibility for the operation of that position.

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*Mr. Grayson, formerly automation officer of an FAA en route air traffic control facility, is currently a principal research scientist on the staff of Battelle Columbus Laboratories assigned to ASRS project research team.

Results

Figure 1 shows the number of ASRS reports, received since July, 1976, that were associated with the briefing of controller reliefs. There was a gradual decrease in reports until October 1978, the only month during which no reports were received. Since that time the number of these reports has tended to increase slightly, but this is not considered to be statistically significant since these reports comprise less than 1% of the total database. The increase may be attributable to recent changes in the immunity feature of the ASRS program, which fostered multiple reporting of the same occurrence.

The source of each of the reports was determined, and reports were categorized on the basis of who committed the described error. The results of these categorizations are given in table 1.

Responsibility for the accuracy of a relief briefing is clearly placed on the person providing the briefing (here, the relieved controller). It is not surprising, therefore, that most of the briefing-of-relief (BOR) problems were enabled by the relieved controller. The issue under study here is not the placing of blame, but the factors that caused the BOR to be inadequate.

The BOR problems were next classified according to the information-transfer problems reported; the results are shown in table 2.

Factors thought to be important in BOR problems were evaluated; they are summarized in table 3. More than one factor was assigned to certain reports.

These factors, alone and in combination, were then studied further with the hope of identifying the root causes of the occurrences and the procedures or practices that could have prevented them.

TABLE 1.– REPORT SOURCES: HUMAN ERRORS IN BRIEFING-OF-RELIEF REPORTS

	Error committed by			
Originator of report	Relieved controller	Relieving controller	Other person	Total
Relieved controller	18	2	1	21
Relieving controller	13	6	4	23
Other person	5	1	2	8
Total	36	9	7	52

TABLE 2.– CLASSIFICATION OF BRIEFING-OF-RELIEF DEFECTS

Category	Number of occurrences
Absent briefing	4
Incomplete briefing	21
Inaccurate briefing	26
Total occurrences	52

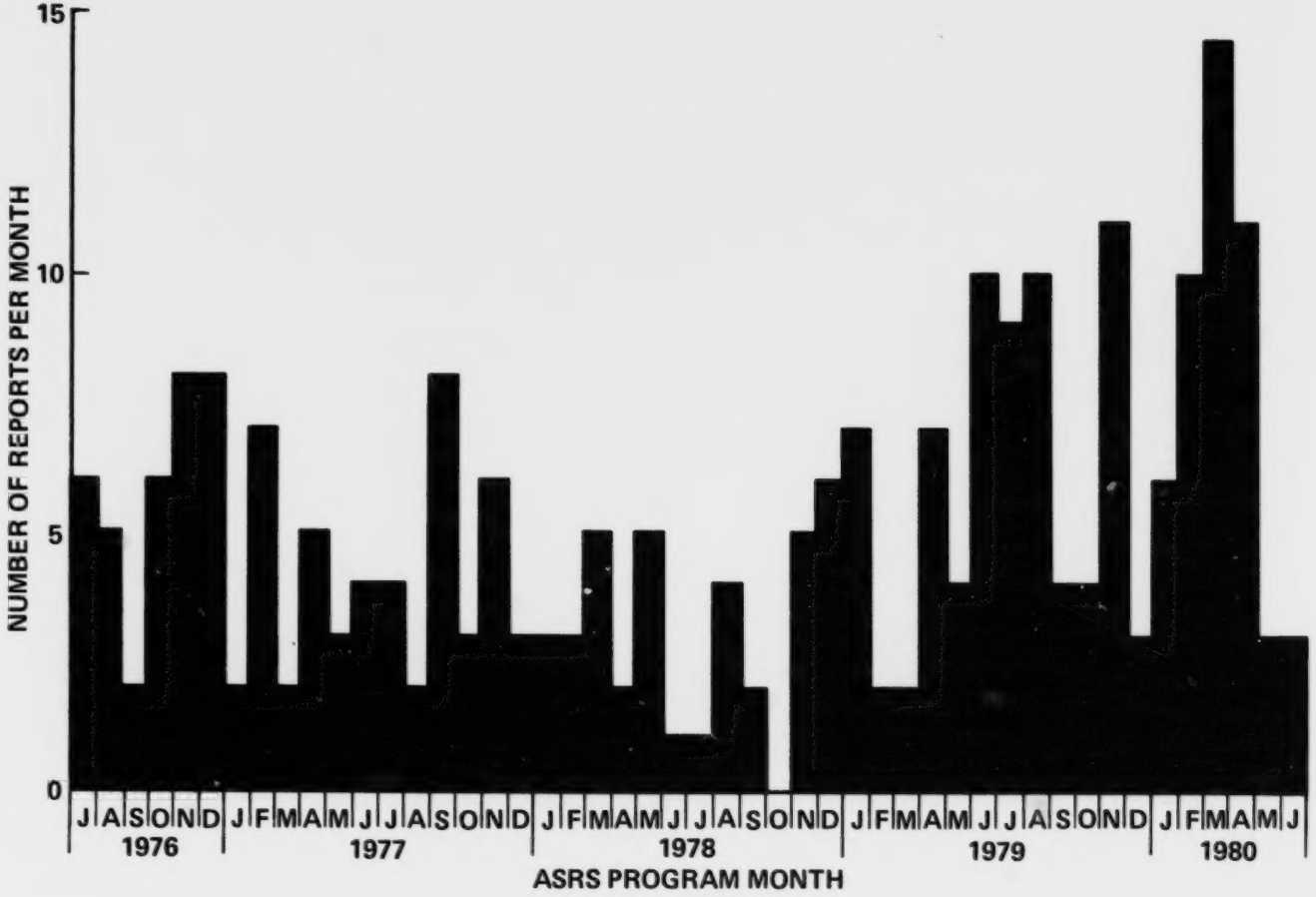
15
10
5
0
NUMBER OF REPORTS PER MONTH
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1976
1977
1978
1979
1980
ASRS PROGRAM MONTH

Figure 1.– Monthly receipts of ASRS reports associated with briefing of relief.

TABLE 3.– FACTORS ASSOCIATED WITH BRIEFING-OF-RELIEF OCCURRENCES

Factor	Number of occurrences
Nonrecall of pertinent information	14
Failure of technique	11
Failure of perception	8
Complacency	5
Distraction	4
Message ambiguity	2
Workload	2
Inattention	2
Misidentification of aircraft	2
Other factors	7

Discussion

Although the data set consisted of a relatively small number of reports, the safety significance of briefing errors is indicated by the fact that, in most cases, the consequences of such errors were serious:

> Assuming the final position the controller released aircraft B. When B turned downwind, A departed and was immediately in conflict with B. Aircraft A took evasive action to climb above B, passing over him by 600 ft. Probable contributing factor – volume of traffic resulted in an incomplete position briefing.

The following sections describe each type of error and discuss the enabling factors observed in connection with them. Also covered are a subset of occurrences associated with correct briefings and a discussion of methods for reducing the occurrence of briefing errors.

Failure to brief relieving controller– The responsibility for providing a relief briefing is defined in FAA agency order 7110.78A, effective July, 1978 and related facility orders, all of which require that a controller being relieved *shall* orally brief the relieving controller; the content of the oral briefing is specified. ASRS reports show no evidence of misunderstanding of this precept. The following quotations bear this out:

> . . . This deviation was caused by the relieved controller failing to adequately brief his relief.

* * *

> . . . This situation occurred, I believe, because the air traffic controller was not properly briefed on the recovery profile being used.

Yet in five cases in this sample, no relief briefing was given, most frequently because of heavy traffic workload; the relieved controller was too busy with current traffic to provide a briefing.

> Traffic built to a point where more controllers were needed. The controller who was working all positions was too busy to brief me when I attempted to take radar west and a final position.

* * *

> Supervisor came back to sector with a headset and pulled out my headset plug. I immediately asked him if he was ready for a mandatory briefing and he told me to relieve another sector and that he needed no briefing. I consider this a double standard since controllers are mandated to give a full briefing before being relieved from duty.

In the latter case, a supervisor assumed the position, stating to the relieved controller that he needed no formal briefing since he was already familiar with the traffic situation. Although this may well have been true, he might still have been unaware of other pertinent information that could have been transferred in a formal, check-listed briefing.

Incomplete or inaccurate briefings– Twenty-one occurrences involved an incomplete briefing (failure to transfer relevant information). Twenty-six involved the transfer of inaccurate information. The factors in these two categories were examined.

Of the 21 incomplete briefings, 9 involved a failure to recall information. This factor was also found in 7 of 26 inaccurate briefings. Examination of these occurrences indicated that the information that was not recalled was available at the position in about half the cases.

> The new controller was told that aircraft A had been stopped at FL330. Tape recordings indicate that A was never recleared to FL330. When he reported in he advised climbing to FL370. The controller acknowledged but did not verify the assigned altitude. Later aircraft B requested descent clearance, and the controller noticed the A and B targets merging as A was leaving FL348.

In other cases, the information was not immediately available because of incorrect recall of a clearance, failure to mark flight progress strips during a holding operation, no transponder code or an incorrect code, and similar irregularities.

> We were requested by an inbound sector controller to move 21,000 traffic to 19,000 and asked what an aircraft at 23,000 was doing here. We were then advised that the adjacent sector was holding at 20,000 up. I was not aware of the holding stack and neither was the controller I relieved. He should have been advised of the stack by the coordinator.

* * *

> Aircraft A called stating he was on frequency at 6,000. Assuming it was his initial call-up I gave him the beacon code on the flight-progress strip. A few seconds later

he appeared about 1 mile behind aircraft B. It was found in the system error investigation that (1) the relieved controller had been in contact with A and amended his clearance assigning a heading of 090°, (2) had forgotten about A at the time of relief, and (3) the aircraft had not been assigned its correct code, which would have resulted in auto acquisition.

Perceptual errors were uncommon in incomplete briefings but were the next most common factor in inaccurate briefings. In at least half of the six cases cited in this category, the information was correct in the full data block or the flight-progress strip, but was not read or was misread during the briefing. In one case, there was a conflict between the two sources of information and the wrong one was used.

During the briefing of relief checklist, I was advised by the relieved controller that B was level at 7,000 due to A westbound at 8,000. The adjacent Center called and advised that the two aircraft passed within 1/4 mile at 7,000. No altitude readouts were noticed by me. I only had the information from the relieved controller.

Technique failures were cited in one fifth of the incomplete or inaccurate briefings. In most cases, the information was available but was not utilized in the briefing. In the cases where it was not available, this was because of a previous error by the relieved controller.

When I was briefed by the relieved controller, he did not mention anything about traffic holding at XYZ, nor was anything written about it at the sector. Approach Control later asked what altitude the inbounds were out of if they were descending. Later, Approach Control advised that the aircraft were clear of XYZ. Investigation revealed that holding had been coordinated at XYZ but no written entry was made. The trainer controller also failed to mark it down and did not brief his relief.

* * *

A was descending to 8,000. The aircraft track, data block, and flight plan were accidentally removed from the radarscope and computer as A left 28,300. One minute later I was relieved and briefed my replacement on all of the aircraft represented by data blocks. I did not realize A had been removed. SMT B had cancelled IFR and the incorrect computer identification number was used.

A few of these occurrences involved system factors. In one case of nonrecall, the flight-progress strip had not been delivered to the position and the aircraft tag had dropped from the radarscope; in a second case, the aircraft was on the wrong beacon code. In a third case, a controller was being relieved after only 3 minutes on the sector. Several other human factors were implicated in the reports, however. Distractions were cited in four instances, workload in two. Complacency or inattention were thought to be factors in seven occurrences.

While briefing my relief, I was interrupted by the Center several times on the hand-off lines. Due to the interruptions (I felt) I overlooked a point-out for sequence that I had previously given another controller. My reliever assumed the position and overtook the sequenced aircraft with another faster aircraft. Computer tapes indicated

that I had taken the handoff via computer and rogered the aircraft checking in on frequency.

* * *

The radio button was off when aircraft A said he did not want a visual to runway 32. I was being relieved by another controller. The two aircraft got extremely close over the outer marker. Probable cause: either lazy relief procedures or radio problems.

Errors by relieving controller– In nine occurrences, an error was committed by the relieving controller. These reports were examined to determine the error patterns.

In one case, the relieving approach controller assumed that an observed target was an arriving aircraft that had previously been transferred to tower frequency. He then vectored a subsequent arriving aircraft to within 200 ft of the preceding arrival aircraft.

Why did it occur? Poor radar due to weather, weather conditions, misidentified target, poor cooperation among controllers, all positions not being alert to the situation.

In two instances failure to recall pertinent information during the briefing resulted a hazardous incident.

We were cleared to tower frequency just prior to the outer marker and made another request for clearance for an approach. No reply, went to tower frequency and were cleared to land. Requested approval for approach which was granted. Started high rate of descent, broke out at 800 ft at middle marker too high and too fast. Cleared back to Approach Control. Controller apologized for the mixup, claimed he had just relieved another controller and was told we had been cleared for the approach.

* * *

When I relieved the previous controller, I was told that aircraft A was released to Sector 23 and on to Sector 35. Sector 35 called and asked the status of A. At the time I did not recall what it was. I later learned that A was in Sector 35 airspace and no handoff had been made.

In one instance, the relieving controller assumed that a VFR aircraft receiving Stage III radar service would be assigned 6,500 instead of 7,000 ft, which had been assigned by the previous controller.

Position relief had occurred just prior to the incident. Possible cause: problems in briefing of relief. Better briefing would lead to a better awareness of the situation by the relieving controller.

A controller moved to a handoff position to assist a controller who had become very busy. The coordinator pointed out an aircraft, stating "This aircraft is for an ASR," which was heard as "This aircraft is VFR."

> I believe that I was not properly briefed and that the radar controller and the coordinator were not communicating properly.

In a similar case the relieving controller received a message correctly but misinterpreted its meaning.

> The relieved controller advised me that aircraft A was "going over the top" of aircraft B. I believed this to mean an approach to a 360° overhead. Failure to understand or my assumption that A was an overhead approach contributed to this incident as well as failure to inform or make certain that the relieving controller understood the situation.

Thus a variety of human error factors can be present when the relieving controller makes an error in the period immediately following position relief.

Control errors associated with relief briefings– Several reports related to errors that occurred in association with relief briefings not in themselves faulty. Errors or oversights by the relieved controller prior to the briefing can result in a reportable incident after the relieving controller has assumed the operation of a control position; other control errors occur shortly after the transfer of responsibility for the position. Both relieving and relieved controllers reported errors in control during the conduct of the briefing.

> Evasive action should have been taken but it was too late when finally noticed by the controller. He forgot to turn A in on the localizer while he was briefing another controller who was relieving him.

It is noteworthy that a relief briefing is itself a distraction, albeit a necessary one, involving increased workload for the controller providing it. Though the relieving controller may receive a complete and accurate briefing, it also appears that it commonly takes him a few minutes to become fully comfortable with the traffic situation. During these periods, mistakes can occur if controllers are not especially alert for them.

Reduction of Errors in Briefing Controller Reliefs

It is self-evident that controllers should and do strive to prevent errors in relief briefings; the FAA has stressed the importance of this. Certain lessons in the reports studied here may further assist in reducing these errors.

The three most common factors in these occurrences were nonrecall (failure to remember pertinent information), perceptual errors (failure to perceive or notice pertinent information), and technique errors (failure to transfer pertinent information). The fact that pertinent information may not be immediately available at the time of a transfer of control points up the importance of written notes to assist the recall process. "Scratch pad" notations can be helpful to the briefing

controller and more helpful to his relief during his initial minutes on the position. Standardization of procedures and phraseology in the conduct of briefings can reduce ambiguity and the likelihood of misinterpretation of the information being transferred.

In those cases in which traffic workload tended to prevent or inhibit the briefing process, the basic problem was that the briefer had to retain his grasp of the changing traffic situation and maintain radio communications while delivering the briefing. This is especially difficult because most controllers are conditioned, properly, to respond to any radio or telephone call as a first priority matter. However, when the volume is such that the briefing is being delayed, this priority can in some cases be modified judiciously. If no emergency is in progress, most routine radio contacts can be delayed briefly without causing problems, or a second specialist can monitor the frequency accumulating calls on standby while the briefing proceeds. If this or similar techniques cannot be used, then a better technique would be to delay relief temporarily, allowing the relieving controller to monitor the situation until a formal briefing opportunity presents itself. Considerable information can be transferred within a few seconds given the undivided attention of a reliever who has monitored for a while. In any case, every effort should be made to conduct a formal briefing – especially under heavy traffic conditions when there is the least margin for error.

ASRS reports indicate a presumption by reporters that the relieved controller is solely responsible for the completeness and accuracy of the information contained in the oral briefing.

> I relieved the radar controller and received a briefing on three jets landing in the XYZ terminal area. Nothing was said in the briefing about aircraft A at 12,000 with no transponder. The jets had received clearance to 11,000, 9,000, and 7,000 from the previous controller. I assumed the position and continued vectoring the jets in trail and failed to notice the strip at the very bottom of the board on aircraft A at 12,000.

This indicates a strict interpretation of the language of FAA agency order 7110.78A. It is obvious that the relieved controller must bear responsibility for any information that is known only to him. However, much of the data transferred during the briefing can be verified by a thorough check of the radar display; by contents of full and limited data blocks where available; and by flight-progress strips, which are nearly always posted and available concurrently with radar information. Corroboration of the data supplied by the relieved controller using all available sources might improve the quality of the briefing process if this were made a direct responsibility of the relieving controller.

This is also important because the relieved controller may well be tired after handling heavy traffic, or bored after a long period of low activity. The relieving controller should be alert to possible errors or omissions in the information being given him. Though the responsibility for the briefing remains with the relieved controller, his counterpart can be of substantial help to him in discharging it.

Summary

Failures in the briefing of relieving controllers, as observed in ASRS reports, appear to be a continuing problem, though one that has been alleviated to an extent by various efforts over the

past 3 years. Failure to recall information is an important enabling factor; failures to check the information and to transfer it when available are also major factors. The elements of such failures are always present in this critical task; relieving controllers can be of appreciable assistance in minimizing errors in the information transfer process.

ALTIMETER READING AND SETTING ERRORS AS FACTORS IN AVIATION SAFETY

John C. Hemingway*

Summary

An analytical investigation was conducted using reported ASRS altitude-related occurrences to determine the extent to which altitude errors were associated with different types of altimeter designs. The results of the ASRS analysis were in general agreement with findings from a concurrent review of the altimetry literature. Particularly noteworthy were performance differences between three-pointer, drum-pointer, and counter-drum-pointer types of altimeters. Of equal interest were numerous instances of altitude excursions associated with reference-pressure setting errors. ASRS associated, enabling, and recovery factors were examined to provide insight into the nature of the altitude monitoring and setting errors.

Introduction

Proper maintenance of assigned altitude is a vital factor in the safe conduct of normal flight operations. This study was performed to investigate selected abnormal factors that contribute to altitude deviations. Specifically of interest were man-machine, control, and display factors involved in altitude monitoring.

Altimeter Descriptions

A typical "three-pointer altimeter" is shown in figure 1. The three progressively shorter needles denote altitude in 100-, 1,000-, and 10,000-ft intervals, respectively. Each complete revolution of the 100-ft pointer indicates a change in altitude of 1,000 ft, as indicated by the 1,000-ft pointer. The shortest 10,000-ft needle is incremented one unit with each complete revolution of the 1,000-ft pointer.

A "drum-pointer-type altimeter" is shown in figure 2. To the right of center of this instrument is a window containing two rotating counters which indicate feet in units of thousands and ten-thousands. Each complete revolution of the single pointer increments altitude by 1,000 ft. Whenever the aircraft is below 10,000 ft, a yoke flag appears over the innermost counter.

Typical "counter-drum-pointer and counter altimeters" are illustrated in figures 3 and 4. Precise altitude tracking is maintained by means of the single pointer; a five-place numeric readout is available on the dial face for quick altitude reference. The basic design of these two instruments is similar, except that newer counter-pointer altimeters employ a snap-type action to rotate the digits; the counter-drum-pointer retains an analog motion with an expanded hundreds window to permit correct interpolation to the nearest hundreds place.

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*Mr. Hemingway is a research psychologist with the Aviation Safety Research Office, Ames Research Center.

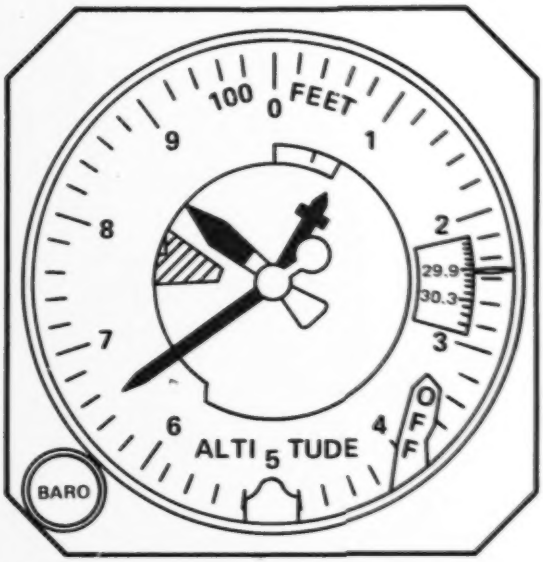

Figure 1.– Three-pointer altimeter.

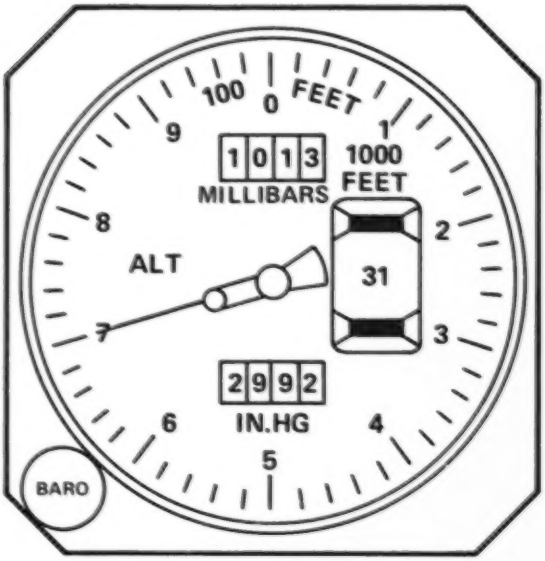

Figure 2.– Drum-pointer altimeter.

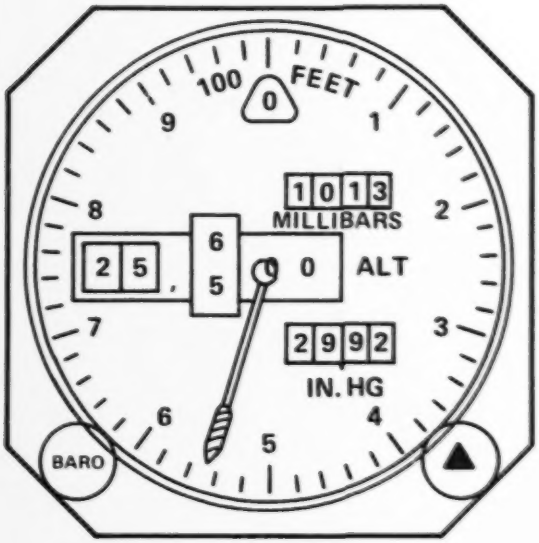

Figure 3.– Counter-drum-pointer altimeter.

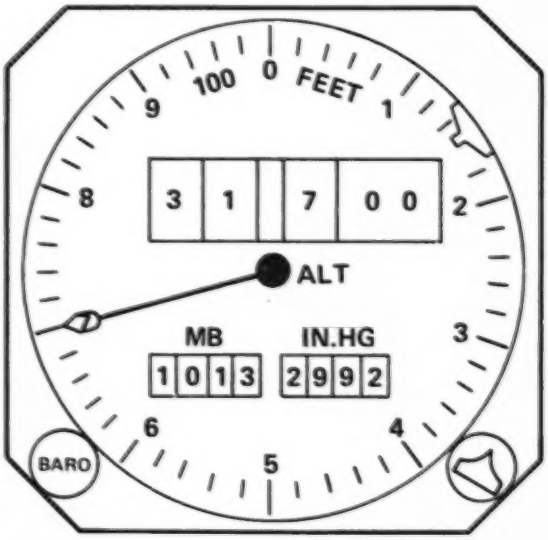

Figure 4.– Counter-pointer altimeter.

Kollsman windows appear on all four instruments and display barometric pressure reference settings in either millibars or inches of mercury or both. Adjustments are made by means of the small knob on the front of the instrument cases.

Approach

This investigation began with an Aviation Safety Reporting System (ASRS) computer search. There were 12,660 reports in the database. The keyword ALTIMETER was used for the retrieval, cross-referenced to ENABLING, RECOVERY, and ASSOCIATED factors. Ninety-six incident reports were identified and retrieved from the system. Each report was reviewed and assigned to one of the three error categories shown in table 1. Only those reports falling in the first two error categories, altimeter reading and setting errors, were retained for further analysis. These reports were reexamined to uncover major contributing factors, and catalogued accordingly. Each subgroup was subsequently analyzed to develop numerical tallies, and to uncover possible patterns.

A second study helped clarify specific patterns that appeared to be evolving from the ASRS analysis. Findings from 20 technical reports about reading performance differences on various altimeters were synthesized and compared with the ASRS findings. This effort produced substantial support for the results of the former analysis.

TABLE 1.– ASRS ALTITUDE ERROR SUMMARY TABLE

Error category	Number of citations
Altitude reading errors	
Confirmed	10
Suspected	3
Reference-pressure setting errors	
Confirmed	31
Suspected	5
Procedural and communications errors	32
Total	81

Results

The three major categories of altitude error derived from the 96 ASRS altimeter-related incident reports are shown in Table 1. The number of recorded occurrences associated with each error category is provided for comparison. Of the 96 ASRS reports identified, about 17% failed to fit one of the major categories; they were discarded. The discarded reports included such factors as "bug" setting errors, equipment malfunctions, and turbulence-related altimetry problems. Other incident reports clearly fell into more than one error category, such as an erroneous air traffic control (ATC) communication resulting in an incorrect barometric pressure setting by the aircrew. In such cases an error was recorded against both error categories. Examples of other compound error occurrences are provided in the Discussion section.

The following results are based on an analysis of the enabling and associated recovery factors identified within the altitude-reading and pressure-setting error categories. (Enabling factors are present and essential to the chain of events composing an occurrence; associated factors are present, related, but not essential to the chain; and recovery factors are those that preclude the final event being an accident.)

Altitude-reading errors– Most of the ASRS incident reports in this category contained either 1,000- or 10,000-ft altitude reading errors. Associated factors such as instrument meteorological conditions (IMC), turbulence, high workload, fatigue, or distractions contributed to altitude-reading errors. In several instances, pilots misread by 1,000- or 10,000-ft intervals, and failed to detect the discrepancies during instrument scans. These findings appeared to be related to generic altimeter

design types; for example, six altitude excursions were recorded against the three-pointer altimeter, three against the drum-pointer, and only one against the counter-drum-pointer. Selected narrative reports of these occurrences are provided in the Discussion section.

The secondary investigation of the literature strongly reinforced suspected reading performance differences between the generic altimeter design types. Consistent with ASRS findings, accuracy and error response were poorest for the three-pointer, and only slightly better for the drum-pointer altimeters. Both 1,000- and 10,000-ft reading errors were shown to be directly related to the three-pointer instrument; the drum-pointer altimeter was primarily associated with 1,000-ft errors. The counter-pointer and counter-drum-pointer altimeters were both shown to provide consistently superior performance over older forms of altitude information display, but possible performance differences have not yet been adequately assessed between these two types of instruments.

Reference-pressure setting errors– This category of error, although unanticipated, occurred frequently in these reports. Values for reported barometric pressure setting errors ranged between 0.06 and 1.02 in. of mercury, but with the 1.00-in. setting error accounting for more than 60% of the reported occurrences. The smallest value corresponds to a 60-ft altitude error at sea level, and the largest value is over 1,000 ft. The results of an analysis of the associated and enabling factors responsible for reference-pressure setting errors are presented in table 2. These factors were catalogued directly from the 36 ASRS reports cited in error category 2 of table 1.

TABLE 2.– REFERENCE-PRESSURE SETTING ERROR SUMMARY TABLE

Associated and enabling factors	Number of citations
Psychophysiological factors	8
High workload	8
Distractions/interruptions	7
Fatigue	2
Operational factors	
Communication/coordination errors	15
Procedural/familiarization/briefing errors	17
Positive control area reference-pressure setting	7
Maximum effort descent profiles	4
Overnight layovers	3
Environmental factors	
Barometric pressure changes	13
Turbulence	3
Instrument-related problems	
Kollsman window reading errors	5
Cockpit altimeter nonstandardization	3
Instrument lag	2
Station barometer inaccuracies	3
Total	100

The effects of the first category of factors (psychophysiological) cited by ASRS reporters are well known to pilots, who attempt to guard against serious psychophysiological symptoms. The second group, operational factors, warrants further considerations.

Communication-coordination errors: These errors principally involved air-to-ground, ATIS, and ATC communication problems. Enunciation, delivery speed, lack of brevity, and interference with ATIS transmissions accounted for one third of these errors (see the Safety Reports section of this report). The remainder involved ATC communications errors; transmissions of erroneous barometric pressures; omissions; and lack of vigilance in tracking, coordinating, and reporting altitude discrepancies.

Procedural/familiarization/briefing errors: Failure to adhere strictly to cockpit procedures and checklists, to request confirmations, to attend to altitude alerts, and to prebrief on weather and clearances accounted for the errors in this category.

Positive control area reference-pressure setting: High workload or distributions due to turbulence, maximum effort descent profiles, or equipment failures were cited as factors contributing to the failure to reset reference-pressure when passing through FL180.

Maximum effort descent profiles: Four ASRS reporters indicated that this factor was responsible for heavy workload conditions, conducive to erroneous pressure settings, and other command and control errors.

Overnight layovers: Failure to examine the Kollsman window reading and the indicated field elevation following overnight layovers resulted in three erroneous reference-pressure setting errors. A falling barometer was cited in two cases; the third was attributed to a maintenance adjustment.

Environmental factors included the pilot's inability to associate a rapidly changing barometer with the required reference-pressure setting. Moderate to heavy turbulence was cited as increasing crew workload and vibration in the cockpit, detracting from pilot performance.

The final category, instrument-related factors, included display hardware problems, such as (1) small numerics in the Kollsman window, (2) altimeter display mixes leading to excessive time required to read the instruments, and reading errors, (3) instrument response lag contributing to system error, and (4) inaccurate barometric pressure measurement and reporting between stations.

The recovery factors cited by the ASRS reporters for the incident reports analyzed in table 2 are shown in table 3.

TABLE 3.- SUMMARY TABLE OF RECOVERY FACTORS

Recovery factor	Number of citations
Altitude alert	3
Air traffic controller (Mode-C)	15
Radio altitude or glide-slope cross-check	6
Visual perception	11
Communications monitoring	3

Recovery from unintentional altitude excursions was most often initiated by an air traffic controller monitoring Mode-C altitude, by a fellow crewmember, or by another aircraft at a similar altitude. Several of the ASRS reports contained accounts of potential conflicts due to undetected altitude excursions.

Discussion

The major categories of interest in this investigation were altimeter-reading and pressure-setting errors. These are equally insidious since the result places an aircraft and its unsuspecting crew at an improper altitude. An examination of both groups of ASRS reports uncovered and highlighted other associated and possible recovery factors. The following examples from the ASRS database illustrate the correlation between altitude-reading errors and altimeter-design types. The first three ASRS narrative excerpts concern three-pointer-type instruments; the fourth represents a combined error occurrence for an aircraft equipped with a drum-pointer and three-pointer altimeter.

> 1. While climbing to cleared altitude of FL240, ABC Center called and asked our altitude. I responded 12,000 climbing. Center asked altitude confirmation. I again looked at the altimeter, and again responded 12,800 climbing. Center said altitude readout was 22,800 ft. I rechecked and realized I had misread altimeter by

10,000 ft. First time for me, but I have seen it done before on four occasions in 23 years. Obviously, once is enough under the right circumstances.

* * *

2. We had been cleared to 27,000 ft direct to ABC. We then received a clearance to 13,000 ft and were asked to increase our speed as there was traffic behind us. The first officer was flying the airplane and I was working the radio. The first officer leveled off at 23,000 ft, thinking he was at 13,000 ft. Scattered clouds and haze obscured ground visibility. Center then cleared us to cross ABC VORTAC at 6,000 ft and to report showing. At 20,000 ft the first officer slowed to 250, and I reported 10,000 slowing. He then descended to 16,000 ft, thinking he was at 6,000 ft, and I reported 6,000 ft. Center changed us over to ABC Approach Control, and I contacted Approach when level at 6,000. The Controller then said that Center had a problem with our altitude transponder readout and that he showed us at 16,000 ft on his altitude readout. We checked our altitude, and immediately realized that we had been misreading our altimeter, and descended immediately to 6,000 ft VFR.

* * *

3. Following radar traffic advisory, the whole flightcrew was on alert for traffic in the turn. While still in the turn, first officer gave the required callout of approaching assigned altitude. I misread the altimeter at 6,000 ft, thinking it was 5,000. First officer repeated that we were only cleared to 6,000 ft. At about 6,300, I radically reduced power and pitched the aircraft down as rapidly as I thought safe, and the altitude peaked out at 6,700 ft.

* * *

4. I was assigned an altitude of 9,000 ft. My copilot was flying the aircraft. At 8,000 I called out one-thousand to go, which is SOP, and he acknowledged. Approximately 15 minutes later, Center controller asked us to verify our altitude, which turned out to be 8,000, not 9,000 ft as assigned. First, why did we level off at 8,000, considering the above conditions? And second, why did we both miss the error? My altimeter is a drum type encoding, and the copilot's a Kollsman three-pointer barometric type.

These four incidents attest to the potential gravity of misreading altimeters. The potential for significant reading errors is increased when three-pointer altimeters are installed in modern aircraft capable of high climb and descent rates and that are routinely operated at much higher altitudes than previous-generation aircraft. Cabin distractions, traffic advisories, high-task loading, night and maneuvering flight operations, and different altimeter mixes in the cockpit were cited as other factors associated with this error category. Alert controllers with Mode-C altitude readouts were most often cited as being instrumental in detecting altitude excursions prior to crew recognition. Vigilance in internal and external altitude monitoring and communications was also a potential recovery factor.

An analysis of associated and enabling factors contributing to the second error category, reference-pressure setting errors, is contained in table 2. The following excerpts from ASRS narrative reports illustrate how these factors may interact and contribute to reference-pressure setting errors, resulting in altitude errors and excursions.

1. This incident involved climbing to and leveling off at an altitude 1,000 ft high due to both pilot and copilot setting the wrong barometric pressure prior to departure. Upon starting engines ABC ATIS was used to gain altimeter setting of 29.84. Apparently the altimeters had previously been set near 28.80, because only a small adjustment was required to set 28.84. Both myself and the copilot stated 29.84 and set the altimeter at 28.84. This is a pointer/drum altimeter and with a field elevation of approximately 1,200 ft, we saw the hundreds pointer slightly below 200 ft and a "1" in the drum. It did not stand out to catch our attention – it looked O.K. Cleared to 4,000 ft; during climb-out the copilot stated a passing altitude cleared for 4,000 ft, and ATC noted our Mode-C as 5,000 ft at level-off, questioned us, and said our Mode-C was inoperative. I immediately cross-checked the radar altimeter and noted that we were approximately 1,000 ft higher than 4,000 ft indicated (terrain considered). We were then in VFR conditions and started cross-checking altimeters carefully and discovered our mistake – ATC was a factor in alerting us to this mistake – the crew erred in not carefully noting the altimeters.

* * *

2. En route from ABC to DEF at 17,000 ft on V-128. XYZ Center cleared us to descend and cross 30 DME N.S. of DEF at 10,000. First officer was flying and started descent. Captain tuned in ATIS and got out approach chart for DEF. At 30 DME captain looked at altimeter. We were at 11,000 instead of 10,000 ft. First officer had prematurely set his altimeter to DEF field pressure, leveled off too high, as a result of referring to wrong altimeter (normally this change should not be made until below 10,000 ft). We immediately continued descent to 10,000 arriving there by approximately 27 DME and changed over to Approach Control. There was no traffic conflict, but proper altitude crossing was not strictly adhered to, as a result of misreading of altimeters by first officer, and distracting cockpit duties on part of captain at the same time.

* * *

3. Cleared to descend to and maintain 10,000 ft – upon level-off at 10,000 indicated altitude, ABC Center called and advised us that we were at 9,500 ft, and to reset our altimeters to 29.50, and climb to and maintain 10,000 ft, which we did. During descent through FL180, we had become distracted by radio communications and neglected to reset area altimeter.

* * *

4. Center issued ABC altimeter as 30.50 when it was actually 29.48. Aircraft A was inbound to ABC tower en route at 60. With the wrong altimeter setting, aircraft B was also at 60. Aircraft A was at aircraft B's 9:00 position at 4 miles when aircraft B

contacted me and reconfirmed altimeter setting that he received on ATIS. I vectored aircraft B north and descended aircraft A. No incident or systems error occurred because at no time did less than minimum separation of 3 miles exist. I called XYZ Center to discuss this with them and gave them the correct altimeter. The XYZ Center controller advised me that they record altimeter and time on strips next to each other, and he picked off the first three numbers of the time instead of the altimeter setting.

* * *

5. A maximum descent and speed reduction effort was started to comply with the ATC clearance. In the hurried cockpit environment which followed, the center altimeter, normally used as a backup above 10,000 ft, was set to 30.34, when the actual altimeter setting was 29.34, creating a plus 1,000 ft error in that altimeter. The other two altimeters and altitude alert were set properly. The copilot was flying the aircraft, and for some reason was referencing his descent on the center altimeter. As the copilot leveled off at 10,000, with his reference on the center altimeter, which was actually 1,000 ft high, the altitude alert and Center controller simultaneously caught the error.

An alert controller or fellow crewmember is likely to be the best insurance against a potentially catastrophic accident resulting from this category of error. In addition to the ASRS factor analysis, the following comments and observations were submitted by ASRS reporters regarding setting errors:

ATIS is a causal factor when fuzzy reception or misinterpretation occurs for some reason.

* * *

ATIS should contain a LOW/LOW note in these conditions (e.g., when entering a low pressure area).

* * *

Center controller erred by issuing only the last three digits of a four-digit setting. [Abbreviated calls could mask proper differentiation between millibars and inches of mercury.]

* * *

Standardize all altimeters within an air carrier's fleet.

* * *

The small numbers in the Kollsman window are at the root of the problem; we expected to see 29.XX, and the 28.XX was not big enough to alert us.

* * *

We overlooked the fact that we were going into a fairly deep low-pressure area.

* * *

The crew should have been aware that this was incorrect because they knew that they were operating in a low-pressure area.

Conclusions

Altimeters are inherently dangerous instruments in that the information they provide is so vital and must be read from the instrument with accuracy, regardless of how the information is presented. Despite findings from this and other studies, it is unlikely that three-pointer and drum-pointer altimeters will be replaced by counter-pointer or counter-drum-pointer-type instruments in older operational aircraft. Controllers have often been instrumental in detecting altitude excursions prior to crew recognition. Hopefully, ATC personnel will continue to be alert for altitude errors and excursions, particularly the 1,000- and 10,000-ft variety, associated with the three-pointer and drum-pointer types of instruments. Nonetheless, airmen flying aircraft equipped with such altimeters must continue to be sensitive to potential design-induced instrument-reading errors.

More than 60% of the ASRS reports describing reference-pressure setting errors cited a 1,000-ft altitude deviation. This particular setting error causes the greatest hazard by placing the offending aircraft at a cardinal altitude, which is most likely to be occupied by another aircraft. During the severe weather months, when low barometric settings prevail, setting errors have the hazardous potential of decreasing or eliminating terrain clearance. The associated and enabling factors for this specific category of error were cited in table 2. Awareness of these factors should heighten a pilot's vigilance and decrease recurrence of such errors under similar circumstances.

In addition to their normal duties, airmen must be alert to the possibility of erroneous external communications, including reference-pressure setting errors. Improper substitution of an incorrect ATIS tape recording, or a hasty transmission by a misinformed, overloaded controller can make a difference of hundreds of feet of altitude. Proper adherence to established procedures, crew cross-checks, communications verifications, and sensitivity to a falling barometer may be a pilot's only insurance against an altitude excursion or error of this type. Final responsibility for careful altitude monitoring, regardless of instrument or communication considerations, must rest with the aircrew.

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ALERT BULLETINS

Introduction

The Alert Bulletin process enables the ASRS to call attention in a timely manner to safety problems as perceived and reported by members of the aviation community. Following previous practice, this report includes a selected sampling of Alert Bulletins; it is felt that these, and their responses, may offer useful information to participants in the national aviation system. The examples here are arranged under several classifications to aid readers who may have specific interests.

Flight Operations

1. Text of AB: Various locations: Citing an incident involving aircraft electrical power failure during an ILS approach, which deprived the flightcrew of gyro attitude, direction, and turn information, a reporter to ASRS contends that certain commuter-type aircraft are equipped with gyro instruments driven only by the main electrical system. Reporter believes that this instrumentation policy renders the aircraft highly vulnerable to loss of attitude information and that such a system may not conform to the intent of the applicable regulations. He recommends that aircraft in commercial service dependent solely on uninterrupted main electrical power for information critical to flight safety be equipped for emergency use with a standby attitude indicator, driven either by independent electrical supply or by a vacuum source.

Text of FAA Response: In reference to the ASRS Alert Bulletin, FAR Part 135 specifically requires in Section 135.163(H) for multiengine aircraft "Two independent sources of energy (with means of selecting either), of which at least one is an engine-driven pump or generator, each of which is able to drive all gyroscopic instruments and installed so that failure of one instrument or source does not interfere with the energy supply to the remaining instrument or the other energy source." The same reference requires "for single engine aircraft, the rate-of-turn indicator has a source of energy separate from the bank and pitch and direction indicator"; no requirement exists for an additional alternate source of power for the gyroscopic instruments.

The latest revision to Section 135.181 specifically limits the use of single engine aircraft in IMC operations. It permits a single engine aircraft to execute an IFR approach at the destination airport only if unforecast weather conditions are encountered that preclude a VFR approach. The intent of this revision is to restrict single engine IMC operations to an absolute minimum.

* * *

2. Text of AB: Various locations: A controller report notes that some commuter airlines, when adding extra sections to a scheduled flight, assign the basic schedule flight number to the extra sections with the addition of a distinguishing letter; for example, extra sections of ABC Airlines Flight 462 would use call signs such as "ABC 462-A" and "ABC 462-B." Since the flights normally proceed along their routes in-trail, using common communications frequencies, confusion often arises in operation, such as delivery, acknowledgment, and compliance with ATC clearances and instructions. Reporter considers this confusion hazardous and recommends that flight numbers having no phonetic similarity be assigned.

Text of FAA Response: In an effort to obtain more specific information, we met with representatives from the National Flight Data Center. We were informed that due to the nature of the subject reporting system, it is not possible to localize or otherwise identify the operations involved. It was further stated that this Alert Bulletin has been disseminated to all pertinent regional Air Traffic organizations. It was their belief that should a problem of this type be noted within the region, the Air Traffic organization of that region could coordinate the required corrective actions with the appropriate Flight Standards organization. In any case, it is our joint belief that this situation would occur only infrequently, since it normally would occur only when a scheduled commuter flight is overbooked, and a follow-on flight is arranged.

In view of the foregoing, we recommend no further action on this from the headquarters level.

* * *

3. Text of AB: Mullan, ID, Mullan Aviation Weather Reporting Station (S06), and possibly various other locations: Reporting pilot expresses concern over the weather reporting policy in effect at Mullan AWRS (S06). The station reports weather under the identifier "MLP," the identifier for Mullan Pass VOR, thus implying that the information pertains to MLP. In fact, the reported weather is that observed at the AWRS, which is located in the town of Mullan, 6-1/2 miles west of and approximately 2,000 ft lower in elevation than Mullan Pass, where conditions may differ materially. Reporter feels that this method of identifying and reporting can be misleading to pilots attempting flight through Mullan Pass, a widely-used VFR route; specifically, the cloud base as given may suggest that the pass is clear of clouds when, due to the elevation difference between pass and reporting station, the former may be completely obscured. It is reporter's opinion that the identifiers used for weather reporting stations should reflect the locations at which observations are taken and that, in conditions such as exist at Mullan Pass, efforts should be made to determine and report actual ceilings or cloud bases at the critical points, with proper designations. The reporter also feels that, in any case, weather messages from the area should state clearly the cloud-base/pass relationship and the fact that the reported observations relate to a point different geographically and in elevation from the location implied by the identifier.

Text of FAA Response: This report is in error. The weather at Mullan, ID is reported under the identifier S06. It is transmitted by the Tacoma FSS using the correct ident, S06. This weather report is identified in pilot briefings as the "Mullan" weather.

It should be pointed out, however, that the S06 weather is reported only on the hour. There is no continuous observation and special reports are not issued. The best source for weather in Mullan Pass is Walla Walla Flight Watch on frequency 122.0.

Navigation

4. Text of AB: Houston, TX, Hobby Field: A controller reports that numerous pilot complaints have been received of severely erratic cockpit indication of the HUB VORTAC 300° radial within 10 miles of the airport. Controllers' observation substantiates that difficulties exist in accurate flying of the radial on final approach course of the VOR runway 13 approach. Reporter suggests that a new hangar may cause the scalloping by deflecting transmitted signals.

Text of FAA Response: The Houston Hobby Airport uses the VOR primarily for departures. The ILS is the primary approach for runway 13 with minimums 250-3/4, and the VOR is the seconadry approach with minimums 450-1.

As a result of ASRS Alert Bulletin, we had flight inspection check the reported condition. They confirmed that the area in question is rough but not out of tolerance.

However, we have approved a test for elevating the VOR antennas to determine if improvements are possible. The results on this test should be available sometime in November 1979. The VOR facility is surrounded by taxiways and active ramps, the closest of which is about 400 ft from the site. The city is continually building new hangars, parking garages, and other buildings which tends to degrade a VOR signal. All efforts are being made to provide a safe facility with the best possible service.

* * *

5. Text of AB: Seattle, WA, Seattle-Tacoma International Airport: Reporting pilot comments on the absence at Sea-Tac of standard arrival and departure routes, and notes that arriving and departing aircraft must utilize radar vectors in the conduct of these phases of flight. Reporter feels that this policy leads to frequency congestion and, because of the surrounding mountainous terrain, to potential hazard in cases of communication failure. He recommends strongly that SID and STAR procedures incorporating MEA information be developed and implemented at this airport.

Text of FAA Response: SIDs serving Seattle-Tacoma International Airport are currently being developed and should be available for use in the near future. The development of STARs has been delayed due to a lack of navigation aids in the vicinity of the terminal area.

Airports: Facilities and Maintenance

6. Text of AB: Danville, VA, Danville Municipal Airport: A pilot reports that during taxi, at night and in rain, at Danville Municipal Airport, only last-minute close-up sighting enabled him to avoid a collision with an unlighted fuel service island on the apron. The airport is unattended at night. Reporter states that he stopped his aircraft with the propeller separated by a few inches from the nearly-invisible fuel pump and speculates on the explosion or fire that could have resulted from impact. He recommends strongly that this (and other similar) airport installations be well-lighted during hours of darkness.

Text of Airport Operator's Response: We have received your report referring to a near mishap at Danville Municipal Airport, Danville, Virginia. This report leaves us in the "blind and rain" as much as the person reporting the hazard. We have been in operation here for 34 years without any such described incidents. All personnel are safety-conscious and the ramp area is maintained with highest safety standards. We do wonder if the person reporting this was at the Danville Municipal Airport, Danville, Virginia. Also, we would like very much to talk personally with the individual reporting this near accident so that he might point out the danger area if such an area should exist.

* * *

7. Text of AB: Burbank, CA, Burbank-Glendale-Pasadena Airport: A controller report calls attention to the prevalence at certain seasons of high velocity winds from northerly directions which combine with the adjacent rugged terrain to produce wind-shear and turbulence for aircraft on landing approaches to BUR. According to reporter, wind-measuring and the associated control-tower indicating equipment is not available for all runways, and is conspicuously absent for those runways normally used under the wind conditions cited. Reporter recommends that the tower be provided with wind-indicating equipment for all runways, as well as with equipment to detect wind-shear, in order to eliminate the present hazards to aircraft, which are frequently required to break off their approaches as a result of unexpected crosswinds, gusts, and shear.

Text of FAA Response: The Low Level Wind Shear Alert System (LLWSAS) is a system of one centerfield and several peripheral anemometers. It is currently being installed at many air carrier airports throughout the country. The LLWSAS is a real-time computer-controlled data acquisition and display system. It is designed primarily to alert controllers to a low-level horizontal wind shear associated with an advancing thunderstorm gust front or a front. The LLWSAS would not be an effective device to inform controllers of the wind patterns unique to Burbank-Glendale-Pasadena Airport. There currently are no devices available to provide good wind information at other than surface levels. However, perhaps one or two additional well-placed anemometers could provide useful additional surface wind information.

To that extent, FAA Western Region personnel have been asked to investigate the usefulness and feasibility of installing additional anemometers at the subject airport.

* * *

8. Text of AB: Kansas City, MO, Kansas City International Airport: A report describes a recent occurrence at MCI in which a just-landed jet transport, after leaving runway 27 via high-speed turnoff C-7, subsequently rolled one wheel off the pavement and into soft ground while attempting the very sharp turn from C-7 to taxi to the terminal on parallel taxiway C. Reporter, citing other similar taxiway excursions at this airport, feels that fillet areas in such acute taxiway intersections should be paved and recommends that painted guide lines be provided to aid pilots in the safe taxiing of large aircraft. He further suggests that simulator training for pilots should stress the turning limitations of such aircraft resulting from the landing gear geometry.

Text of FAA Response: We agree that pilot training should stress the turning limitations of the particular aircraft in which the pilot is being trained. This is especially the case for those aircraft in which the flightcrew member positions are located a long distance forward of the nose gear; e.g., L-1011, DC-10, B-747. These limitations are normally reviewed and emphasized in the aircraft general phase of the aircraft initial ground school.

Additionally, training in the taxiing maneuver is a regulatory requirement set forth in FAR 121, Appendix E, which requires that training in the maneuver be performed in the aircraft. The aircraft training phase takes place following the simulator training and check ride. It precedes the check ride conducted on the aircraft. Training and checking of competence in the taxi maneuver is an essential part of the airman certification process. While the majority of aircraft simulators in use do not adequately present the realism necessary to provide training in the taxiing maneuver beyond the level of procedures training, we anticipate that realistic taxi training will be conducted in future advanced aircraft simulators.

9. Text of AB: Napa, CA, Napa County Airport: A recent report to ASRS contends that the type of obstruction lighting, on a drawbridge 1-1/2 miles from the approach end of runway 6 and 1 mile from the VOR 6 approach course at Napa County Airport presents a hazard to approaching aircraft under conditions of darkness and low visibility. According to the report, the drawbridge is equipped with two white strobe lights and a green light (to indicate bridge position to river traffic). Reporter asserts that this lighting configuration can be mistaken readily for a runway environment and thus be the cause of confusion to arriving pilots. To eliminate the possibility that the drawbridge may be mistaken for the runway, reporter recommends that the white strobe lights on the bridge be replaced by red, and that an amber light be used in place of the present green one. He also suggests that the situation be noted on appropriate charts.

Text of FAA Response: The NASA ASRS Alert Bulletin has been referred to this office for comment. We are aware of this problem and have been notified by our Airspace Obstruction and Airports Branch, Air Traffic Division, that the lights on the bridge will be modified through the Western Region, to flash in a unique sequence so that they can be distinguished from the runway end identifier lights (REILS). This modification is expected to be completed by the end of January 1980. In the meantime, a NOTAM has been issued placing the REILS out of service until further notice.

* * *

10. Text of AB: Clifton, TX, Clifton Municipal Airport: Pilot reports that Clifton Municipal Airport, listed as having low-intensity runway lighting, presently has a number of the runway lights inoperative. Specifically, according to reporter, only three lights on one side of the runway, five on the other, and one green threshold light at each end of the runway are illuminated. Reporter feels that the cited condition is hazardous, and that the situation should be NOTAMed, and that the airport should be closed to night operations until all runway lights are restored to normal condition.

Text of City Secretary's Response: In reference to your letter, the situation was corrected in early December. As of today's date, January 28, 1980, there are only four bulbs out.

* * *

11. Text of AB: Muncie, IN, Delaware County-Johnson Field Airport; Anderson, IN, Anderson Municipal Airport: Pilot report describes a recent NDB approach to Muncie; the approach was abandoned at a late stage when it became apparent that the procedure had positioned the pilot for landing at Anderson instead. At Muncie the LOM (SELLA) transmits on 365 kHz with identifier MI (--..). At Anderson, 10 miles from Muncie, the LOM (VIDEO) transmits on 371 kHz with identifier AI (.-..). Reporter notes difficulty in accurately tuning some types of ADF receivers to within six kHz and the similarity between the two Morse code identifiers located so near together. He recommends a change of either frequency or identifier or both for one of the two LOMs in the interest of flight safety.

Text of FAA Response: A review of Muncie and Anderson, Indiana NDB facilities and approaches indicates that the frequency separation meets the approved standards established by

Frequency Management. The identifiers of each facility are clear and audible as reported by flight inspection.

In this situation it appears human error was the contributing factor to an unsatisfactory approach to the Muncie Airport.

We recommend no change to the Muncie or Anderson, Indiana, NDB facilities.

Hazards to Flight

12. Text of AB: Chicago, IL, O'Hare International Airport: Reporting air carrier pilot expresses serious concern over an alleged new procedure requiring that SIGMET information not pertinent to the area be broadcast on approach and tower local control frequencies at O'Hare International Airport. Reporter cites a recent instance when, during an approach in near-instrument-minimum weather, with fog, rain, and low ceiling, O'Hare Tower transmitted a SIGMET concerning the Des Moines area (over 200 miles away) throughout his entire approach from 500 ft to landing rollout, blocking tower frequency for any other use and providing dangerous distraction to the flightcrew at a critical time. Reporter states that discussions with controllers support the contention of inefficiencies in this procedure, including periodic traffic backup. He contends that controllers are in agreement with pilots that the procedure is potentially hazardous to flight but, since it is system-mandated policy, the controllers have no alternative to compliance.

Text of FAA Response: Though there have been some changes to the SIGMET procedure, there have been no new changes as it relates to dissemination of SIGMET information by terminal air traffic facilities, including Chicago. Consistent with the efforts to place a greater emphasis on screening the available weather information so that it may be disseminated to those with a need to know, the Federal Aviation Administration has circulated a proposed change to the SIGMET alert procedures. This change proposal, if adopted, will emphasize selective dissemination in the terminal environment, thereby reducing distractions on radio frequencies. For example, it is proposed that local control only broadcast a SIGMET alert when any part of the area described in the SIGMET is within 25 n. mi. of the airport. The radius of coverage increases proportionally with the area of responsibility for the operational position involved.

An analysis of comments concerning the proposal is expected to be completed by September 1979; dependent upon the comments, we will advise NASA of the results of the analysis.

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13. Text of AB: Linden, NJ, Linden Airport: Pilot reports narrowly avoiding collision, during a night takeoff, with a smokestack situated in proximity to the departure end of runway 27 at LDJ. The stack is spotlighted, rather than identified by conventional obstruction lights, making it difficult to discern against the background illumination. The report states that other pilots have experienced the same near-collision hazard. Reporter feels that this obstruction and others at Linden are also inadequately depicted on available charts; he recommends that steps be taken to alleviate the various safety deficiencies at this airport by (1) improving obstruction lighting and (2) revising charts and the AIM Facilities Directory to emphasize the obstructions. He also notes that the Facility Directory indicates runway 18/36 as usable, when it is in fact closed.

Text of FAA Response: In reference to charts and publications, there is a caution note on the Instrument Approach Procedure Charts for Linden, New Jersey, that states: Numerous obstacles close to ends of all runways.

In the Airport/Facility Directory under Airport Remarks for Linden, New Jersey, it states: Off Rys 27, 32, 36 Depart Straight Out to 800.

In the Class II NOTAMS in effect at the time of this report, under Linden, New Jersey, it states: Rwy 18/36 Closed.

A night obstacle illumination inspection flight was conducted at Linden Airport on April 3 to determine the nature, height, and hazards as reported, in the proximity of active runways. Although this highly commercialized area has numerous obstacles, they are considered adequately lighted, marked, and depicted on local charts.

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14. Text of AB: Ft. Lauderdale, FL, Hollywood International Airport: A controller cites a recent instance in which an airliner, cleared for an ILS approach to runway 9 at FLL and maintaining the specified 2,700 ft MSL at the outer fix (PIONN), was forced to take evasive action to avoid colliding with a small aircraft performing practice maneuvers at the same altitude and directly on the approach course. Reporter points out that a designated practice area underlies the approach course in the vicinity of PIONN, extending to 2,699 ft MSL, which is within the TRSA, and suggests that, in the interest of flight safety, (1) this practice area should be relocated, and (2) a buffer zone of at least 500 ft should be established beneath all fixes on a published instrument approach.

Text of FAA Response: The easternmost edge of Alert Area 291-A is located approximately 10.1 n. mi. west of Ft. Lauderdale International Airport. Airspace is from surface to 2,500 ft MSL. Minimum altitude at PIONN intersection (10.1 miles from airport) for intercept of glide slope on 9L ILS approach to Ft. Lauderdale International Airport is 2,700 ft MSL. The base of the Terminal Radar Service Area beyond 5 miles from the airport is 2,500 ft MSL. The practice area does indeed underlie a portion of the Ft. Lauderdale TRSA. A buffer of 200 ft is provided by the present glideslope intercept altitude. Our Southern Regional Office is exploring with Flight Operations the possibility of raising the intercept altitude. A recent flight inspection revealed that 3,000 ft at the PIONN intersection would be satisfactory. This would increase the buffer to 500 ft for aircraft conducting an ILS 9L approach.

Action is under way to divide Alert Area 291-A and relocate in part the practice area. The necessary airspace actions and chart depictions should be accomplished within 6 months.

Military-Civilian Coordination

15. Text of AB: Various locations: A controller reports that specific standards do not exist for IFR separation of nonparticipating traffic from Special Use Airspace boundaries and that ambiguous phraseology in pertinent regulations permits separation based on individual interpretation by controllers of what is "prudent." Reporter, citing the Utah Test and Training Range as an example, feels that air safety is compromised by this policy and that clearly defined standards are required to

clarify the now vague guidelines in use for avoidance, on the one hand of restricted airspace by aircraft under ATC jurisdiction, and on the other of civil-use airspace by aircraft under military control.

Text of FAA Response: Separation standards have been developed for controller application when controlling nonparticipating traffic in the vicinity of Special Use Airspace boundaries. These new procedures are expected to become effective on July 1, 1980.

* * *

16. Text of AB: Maricopa, AZ, Estrella Sailport Airport: A series of reports to ASRS, citing examples, contend that aircraft assigned to flight within nearby military training routes frequently deviate from the limits of the routes and constitute a hazard to glider and training flights operating in the vicinity of Estrella. Reporters recommend that military pilots engaged in high-speed, low-altitude, terrain-following activities in the Estrella area be made aware of the conflict potentialities that exist when they allow their flightpaths to vary from the specified bounds of the training routes.

Text of USAF Response: Luke-based F-4C aircraft use VR 243 regularly. F-104G aircraft regularly use all routes in question. The F-104 FSO states that the F-104 students are never allowed to deviate anywhere near Estrella Sailport. Route widths keep the aircraft well clear. The Luke AFB FSO visited the operator of Estrella Sailport on 6 June 1980. The Sailport operator was given maps and information on Luke's arrival and departure routes. The discussion centered on the joint use of airspace and mutual lookout to prevent a disaster. It was agreed to pass the word to the respective groups of pilots on each other's activities.

Ames Research Center
National Aeronautics and Space Administration
Moffett Field, California 94035, December 5, 1980

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15. Supplementary Notes

16. Abstract

This twelfth quarterly report of ASRS operations contains two special studies. The first, Problems in Briefing of Relief by Air Traffic Controllers, addresses various problems that arise when duty positions are changed by controllers; the second study, Altimeter Reading and Setting Errors as factors in Aviation Safety, discusses problems associated with altitude-indicating instruments. A sample of reports from pilots and controllers is included, covering the topics of ATIS broadcasts and clearance readback problems. The concluding section of the report presents a selection of Alert Bulletins, with their responses.

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